379

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PRINCIPLES OF TAME PASTURE MANAGEMENT

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379

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INTRODUCTION

The mortality of tame pastures runs high. Work unit conservationists in Texas estimate that more than 65 percent of the tame pastures they assist district cooperators to fertilize, seed, and get under way go out within three years after establishing them. It is realized that there is no such thing as a permanent tame pasture unless it is well managed and continually receives maintenance treatment. To secure the most returns it is imperative that more emphasis be given to good management of both native and tame pastures.

The material assembled in this paper is intended to serve as a tool to help Soil Conservation Service employees in assisting farmers to carry out a good pasture management program. It is hoped that this approach will serve as an incentive to develop techniques which can be used to assist SCD Cooperators in establishing and maintaining pastures in a high state of production.

First, however, it will be well to review some basic principles of plant growth.

*Material assembled for use in personnel training meetings.

NATURE'S BASIC FACTORS AFFECTING PLANT GROWTH

There are four basic factors of nature that affect plant growth that must be constantly kept in mind when assisting farmers and ranchers to plan conservation programs on their farms or ranches.

A. Nature Despises a Naked Soil

Nature insists that the earth be clothed with plants. Plants followed immediately the creation of the earth. Nature started with the simplest kind of plants, lichens, molds and mosses, then progressed to annual weeds and grasses and then to perennials - trees, etc. There are plants to cover the earth's surface on dry lands and wet lands -- on sandy lands and clay lands -- on hills and in the valleys -- on poor soils and on fertile soils. Nature despises nakedness of the soil and has provided a raiment of grasses, shrubs and trees to clothe the earth under all conditions of soil and climate except when man intervenes.

B. Nature Tries to Maintain the Kind of Vegetation that Has Been Developed on the Land

Nature provides plants adapted to each kind of soil in all types of climate. There are plants which are adapted to all known soil conditions.

Ecologists refer to it as a natural succession of plant life. As the soil develops in a particular locality and climate, nature supplies plants to fit the conditions that exist--temperature, rainfall, soil unit, etc. Nature provides that plants will succeed each other to the extent that the native pasture, when in excellent condition, will consist of the kind of vegetation that fits the soil and climate so perfectly that no other kinds of plants can move in. Ecologists say that such a condition comprises a climax vegetation. If we are well acquainted with the system, it is possible for us to make a study of the vegetation on a field and determine the stage of demolition or the degree of tearing down or building up of nature's structure which has taken place.

The importance of this basic law of nature in this discussion is to remember that if we establish a tame pasture in areas where it is natural for trees to grow, it will be necessary to combat trees as well as weeds, shrubs, and native grasses if the introduced tame grasses and legumes are to succeed.

It must be remembered that there are two main kinds of pastures--tame and native. Tame pastures are man-made from domesticated native or introduced plants. Native pastures are products of nature. They are what we call rangeland. Both native and tame pastures have their place. Both occupy a definite place in our livestock economy. A man with all native grass may profitably increase the length of his grazing season by seeding some area to cool season tame pasture. A man with a small amount of native grasses can profitably use the native grass during the period that best fits into his program of grazing tame pastures.

Tame pasture, to remain productive, requires more intensive treatment than does native pasture. Closer attention should be given to the growth habits of plants in a tame pasture. Also, a well grounded knowledge of the use of fertilizer is needed to maintain them in a good productive condition.

Tame pastures are made up of domesticated or introduced plants that have proved to be most adapted to the soil and climate of the area. They fit most perfectly

the season of use the pasture is planned to serve. Therefore, man tries to set up a synthetic climax vegetative community to give him seasonal forage for grazing. It will be necessary for man to learn how best to maintain that planned forage composition in spite of nature's constant attempt to replace it with the native vegetation naturally adapted to the region. There will be a continuous battle against woody growth, weeds and grasses that are native to the timber growing areas and with weeds and native grasses in the coast areas.

The soil was built under nature's mixture of plants. They didn't take out more than they put back. A tame pasture plant, in order to produce more, must take more from the soil. When man makes the plants produce more pounds of forage so he can get more pounds of beef, he must learn how and when to put that "more" kinds and amounts of plant nutrients into the soil, how to maintain the soil in its most favorable producing condition and how to graze the forage so it will be capable of using the extra plant food that has been added. Man must always remember that nature tries to maintain the kind of vegetation that it has developed on the land.

C. When the Plant Factory is Dismantled the Plant Roots Perish (Grover Brown's chart is a dramatized portrayal of the "Growing Plant Factory")

The Growing Plant is a Factory

Contrary to popular belief, the bulk of the plant tissue does not occur from directly combining the essential elements obtained from the soil--namely: nitrogen, phosphorus, potash, calcium, minor elements, and water and air.

First, certain changes of form and character of these elements occur in the soil resulting from bacterial action, and organic and inorganic acid action before the plant roots will accept them. When they are picked up by the plant's roots, they are still what may be termed "raw materials."

Second, when these soil elements reach the plant leaf they are converted by a process called photosynthesis into sugars, starches and proteins. This process is a result of sunlight and energy acting on the soil nutrients and water, and the carbon dioxide taken from the air through leaf stomata (pores) in the presence of chlorophyl.

Photosynthesis as a process -- The process by which simple carbohydrates are synthesized from carbon dioxide and water by the chloroplasts of living plant cells in the presence of light (oxygen being a by-product) is generally called photosysthesis.

In simpler words, the growing plant's leaf is a factory. In the green leaf essential elements from the soil are mixed with CO_2 from the air and chlorophyl in the leaf. With the sun's energy, this mixture is converted into foods the plants need to create cells and stem walls for new growth; to give the plant its power of reproduction; to make it healthy in order to resist disease and insects; to bloom and produce seed; to give it power to store a food supply in its roots for emergencies and reproduction.

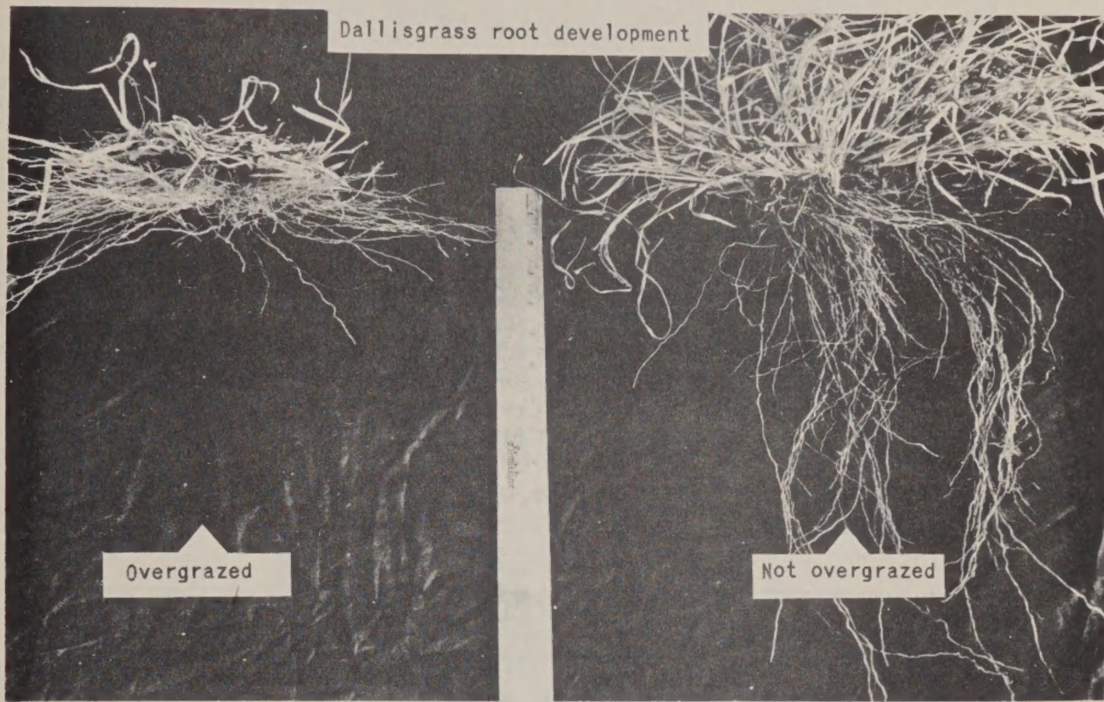
If the concept of a plant being a factory is accepted, it follows that the size of the leaf area is important from a production standpoint. The smaller the leaf surface of a plant is in comparison to the whole plant the less will be its "out-put" of plant food. It follows that a reduced food supply will cut down on plant growth. A starved plant grows little, becomes weak and unhealthy.

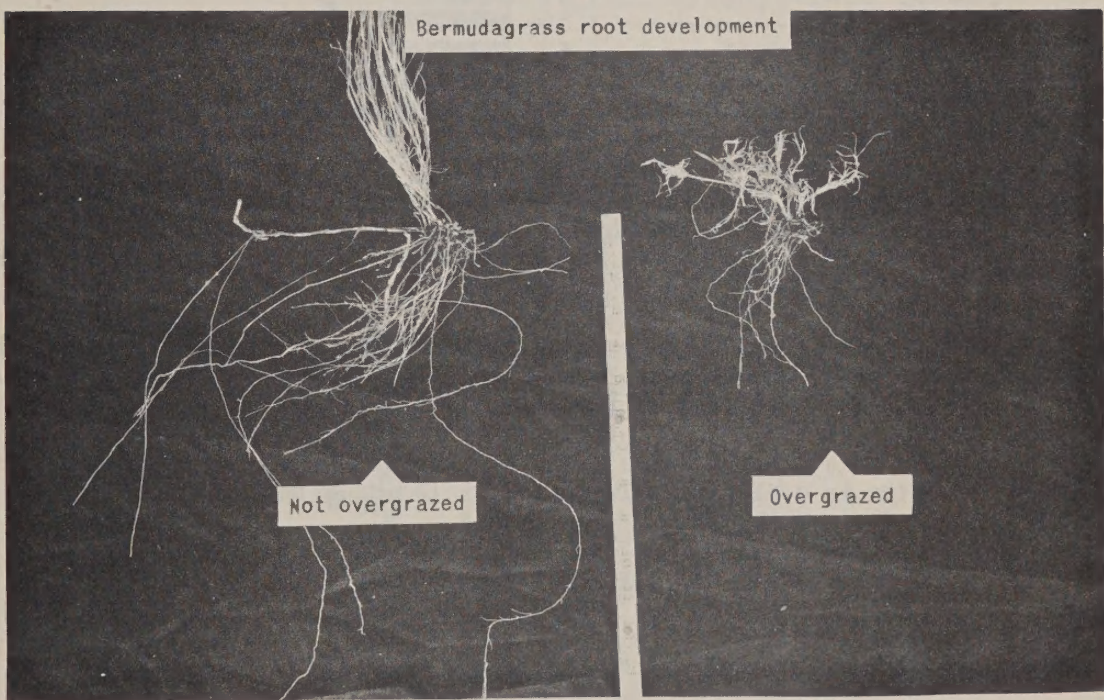
Small factories require fewer laborers than large factories. Fewer facilities are required to transport materials to the small factory than to large ones. In

THE GROWING PLANT IS A FACTORY

Chart dramatizing idea of growing plant factory developed for Grover Brown, Chief, Agronomy Division, Soil Conservation Service, Washington, D.C.

comparison to the plant factory this means reducing the mining operations of the plant. The root system is diminished because it is not needed.





These comparison photographs show how overgrazing the above-ground growth of grasses reduces the size of the root systems of the plants.

Plants are living things. They can be starved or they can be made to grow. They are living factories. They can be run at full capacity or they can be thrown into bankruptcy. If the shoot, which is produced from stored food, is grazed off, another one will probably follow, but if this is continued all season the root will be killed. When the plant factory is dismantled the plant root perishes.

D. One of the Prime Factors Limiting Grass Production is Moisture

Water is nearly always the greatest limiting factor of plant growth.

It takes four to four and one-half gallons of water to produce one ounce of grass (64-72 gallons to produce one pound, 128,000-144,000 gallons to produce one ton). There are 27,154 gallons in an acre inch. Therefore, around four and one-half to five inches of water is required to produce one ton of grass, making one realize how important water is in producing large quantities of forage.

Why do we emphasize this? Because soil is the storehouse for water. The soil must be kept in such a physical condition that it will permit rapid absorption of water and will retain large quantities available for plant use. Hoof pans, plow sole pans and implement compaction must be kept to a minimum. A sufficient cover must be maintained on the soil surface to prevent puddling. Cover and litter also decrease wasteful evaporation by holding soil temperature down.

1. Factors Affecting Water-holding Power of Soils

   a. The kind of soil is important when water-holding capacity is considered.

KINDS OF SOIL	WATER HELD BY 100 LBS. OF SOIL WHEN SATURATED (LBS.)
Sand------------------	25
Sandy Clay-----------	40
Strong Clay----------	50
Cultivated Soil------	52
Garden Soil----------	81
Humus----------------	190

   Since humus has such a high water-holding capacity it is therefore very important that increased organic matter content of soils be accomplished to add to humus improvement and increased water-holding ability.

   b. The condition of the soil affects the rate of intake of water, thus affecting amount of moisture for plant use, as illustrated by Chart A, page 7, The Effect of Plow Pan on Infiltration Rates.

   c. The treatment of soils affects infiltration rate and storage of water in soils, as illustrated in Chart B, page 7.

TAME PASTURE MAINTENANCE (MANAGEMENT)

There are four main requirements for maintaining a good tame pasture.

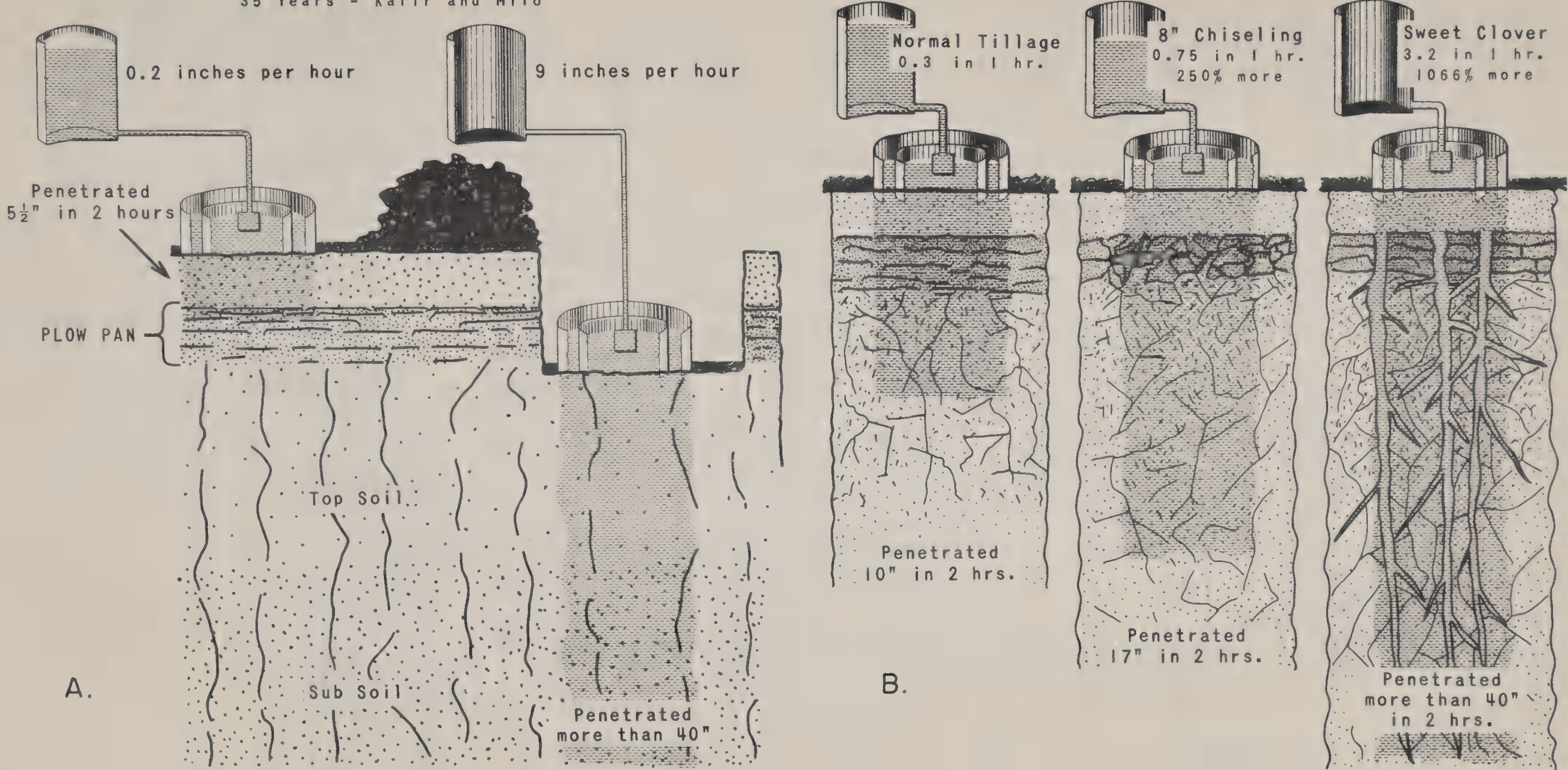
A. Maintaining Good Soil-Plant-Moisture-Air Relationship Provides Suitable Environment for Vigorous Plants.

Five components are distinguished:

1. The mineral matter.

THE EFFECT OF PLOW PAN ON INFILTRATION RATES
Sandy (7X) Soils - Rolling Red Plains Cropped 35 Years - Kafir and Milo

INFLUENCE OF TREATMENT ON INFILTRATION RATES
2X Soil - High Plains



The mineral portion of the soil is customarily classified into several fractions depending upon the size of the particles contained in it.

FRACTION	DIAMETER UNITS OF PARTICLES
Coarse sand	2.0 - 0.2 MM
Fine sand	0.2 - 0.02 MM
Silt sand	0.02 - 0.002 MM
Clay	Less than 0.002 MM

2. The organic matter of the soil

May vary from practically none to as high as 95 percent in the marsh or peat areas.

a. Leaving adequate amounts of forage and litter on the soil surface will:

(1) Help prevent compaction of soil surface by grazing animals

(2) Hold soil temperature down during summer's heat

(3) Add organic matter to soil

(4) Prevent evaporation of soil moisture

(5) Prevent splash damage by rain

(6) Increase absorption of rainwater

(7) Improve aeration of soil

b. Organic matter of the soil may be maintained or increased by:

(1) Mowing to control weeds and brush

(2) Arranging cross fences, feeding places and salt to prevent heavy concentration of grazing

(3) Mow surplus forage to increase litter

(4) Leave high stubble for litter

3. Soil water and soil solution

Since there are varying quantities of chemical compounds--"soil solution" is the most accurate terminology to use. We can for all practical purposes refer to this component as soil water or moisture.

Available Water-holding Capacity of Different Soil Textures:

Texture	Available water per foot of depth Inches
Coarse	.6 - .7
Medium	.7 - 1.5
Fine	1.5 - 3.0

Plants secure most of their water from the upper three feet of soil.

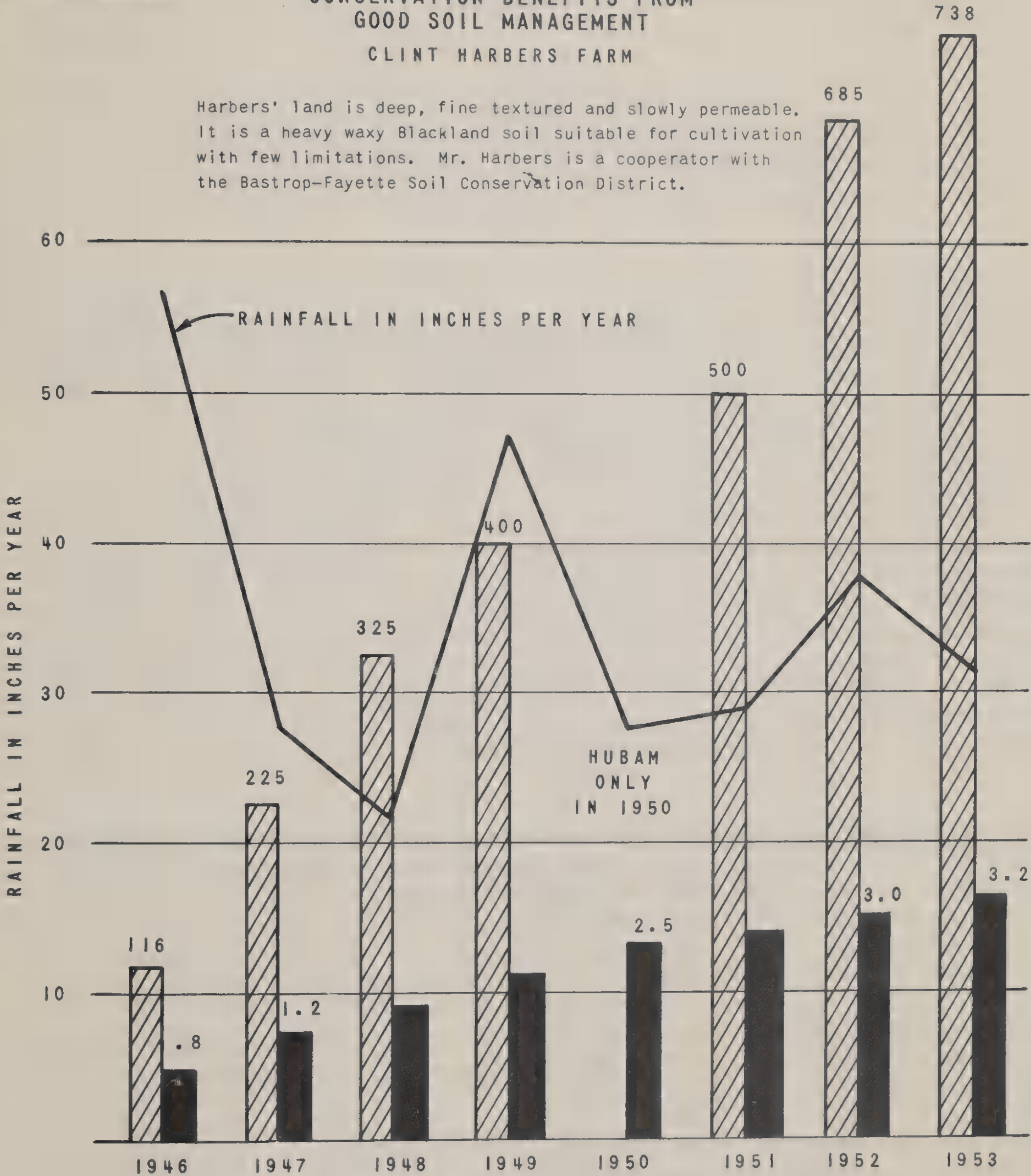
Available moisture in soils varies depending upon texture and structural differences and organic matter content.

Addition of large amounts of organic matter to soils may raise the available moisture capacity above the range given, as illustrated in the above table.

The effect this will have on increased crop production is shown in the chart below.

CONSERVATION BENEFITS FROM GOOD SOIL MANAGEMENT

CLINT HARBERS FARM



Shallow rooted legume used every year preceding cotton.

Lint cotton - pounds per acre

Soil organic matter - per cent (Tested)

Soil organic matter assumed 1948, '49, '51

4. The soil atmosphere

The irregularity of the soil particles in size, shape and arrangement insures the existence of a certain amount of space between them, even in the most densely packed soil. This is termed the pore space of a soil. The pore space of a soil varies from approximately 30 percent to 50 percent of the volume of clay soils, or even higher in soils rich in organic matter. The pore space of any given soil depends largely on its physical condition. Conditions favoring a crumb or granular structure of a soil, for example, usually result in an increase in the pore space. The pore space of a soil may be occupied wholly by air, or wholly by water, but it is generally occupied by both.

The soil air usually contains a higher concentration of CO_2 and a lower concentration of O than the above ground atmosphere. CO_2 may be as high as five percent but the average is about 0.03 percent. This is due more to the metabolistic activities of micro-organisms than to respiration of soil animals and the decomposition of the underground portions of vascular plants.

5. Soil organisms

The soil flora includes bacteria, fungi and algae. Bacteria are generally most abundant. Among them are the nitrifying, sulfofying, nitrogen fixing, ammonifying, and cellulose decomposing bacteria. The numbers of bacteria present vary greatly from soil to soil, and in any one soil vary with seasonal and other fluctuations in soil conditions. Most soils contain between 2,000,000 and 200,000,000 individual bacteria per gram of soil. The number varies according to depth. Subsoils are usually practically devoid of soil bacteria. In general an abundant representation of most species of bacteria is favored in soils by warm temperatures (35^{o} - $45^{o}C$), good aeration, and a good but not superabundant water supply. A high calcium content of the soil is also favorable to the development of most species of bacteria, apparently because it favors a granular structure of the soil, thus improving aeration. Some of the bacteria, on the other hand, are anaerobic and thrive when the aeration of the soil is deficient. The denitrifying bacteria and certain of the N fixing bacteria (clostridium spp.) are examples of anaerobes.

Closely related to the bacteria is a large group of organisms called actinomycetes. The characteristic odor present when soil is newly plowed in the spring is due to substances produced by actinomycetes. Some of the organisms belonging to this group produce plant diseases, such as potato scab. Many carry on the essential activities of decomposing organic matter and making mineral nutrients available for higher plants.

Fungi are, in general, most abundant in soils of acid reaction. In such soils they largely replace bacteria as agents of decomposition of organic matter.

The soil fauna includes protozoa, nematodes, earthworms, insects, insect larvae and burrowing species of higher animals. The earthworms are generally credited with having the most important effects on soil structure, at least in many soils. Their activities result principally in a general loosening of the soil which facilitates both aeration and distribution of water. Many of the other soil animals have similar effects on structural organization of the soil.

Numbers and weights of microorganisms, worms and insects in soils, on the

average, are very great. (From Elizabeth McCoy, University of Wisconsin.)

Kind	Average number per gram of soil	Average weight in pounds per acre foot of soil
Bacteria	1,000,000,000	500 - 1,000
Actinomycetes	10 - 20,000,000	800 - 1,500
Fungi	1,000,000	1,500 - 2,000
Protozoa	1,000,000	200 - 400
Yeasts	1,000	---
Algae	100,000	200 - 300
Worms and Insects		800 - 1,000

B. Maintaining Desired Balance of Legumes and Grasses Keeps Desired Forage Mixture in the Pasture

A mixture of legumes and grasses is most desirable for grazing. Legumes are usually high in protein, calcium, and phosphorus while grasses are usually high in carbohydrates. Legumes take nitrogen from the air thereby making it available for the growth of other plants such as grass.

A mixture of about 60 to 80 percent grass is considered to be most desirable for summer pastures. Tall fescue grass being high in protein requires the use of fewer legumes to meet body requirements of grazing animals.

A desired balance of legumes and grasses may be maintained by:

1. Reseeding or overseeding desirable legumes and grasses which have been taken out, died out, or need to be added to the forage mixture.

2. Refertilizing, adding lime or minor elements based on needs of the soil to encourage the more vigorous growth of plants desired. Increase phosphorus to encourage legumes which will produce nitrogen to encourage grasses.

3. The best season to graze a pasture is during the growing season after the grasses have made a good start. Heavy grazing when the plants are dormant, especially during hot, dry periods, will damage the plants.

4. Cross fencing pastures to permit rotating livestock. This will rest the plants grazed, permit their recovery, maintain plant vigor and encourage even distribution of grazing. It encourages greater plant growth, more efficient use of fertilizer, more uniform palatability and better balance of mixture of vegetation.

5. Providing convenient and clean sources of water to insure better health of animals and more uniform grazing of the pasture.

6. Mowing dominating plants at seeding time to reduce competition with the better plants.

7. Overseeding sod pastures with oats or other annual cool season grass for winter grazing.

   CAUTION: According to Angleton Experiment Station, Texas, and Mississippi Experiment Stations, overseeding established bermudagrass and Dallisgrass pastures with an annual cool season grass may be harmful to the pasture. Recommend:

   a. Apply fertilizer at the same time the oats or other cool season annual grasses are drilled into the pasture. Do not flat break the sod land.

   b. Plant in rows at least 18 inches apart.

C. Providing a high, balanced fertility level helps maintain a high producing and balanced mixture.

If there is sufficient water to produce more forage and the soil condition is favorable, plant nutrients can be added to produce increased forage. This level of available plant foods must be maintained from year to year in order to maintain a high level of forage production. The kinds and amounts of lime and fertilizer needed to produce the kind, quality, and quantity of the forage plants desired can be determined largely by soil tests, experience and close observation.

Efficiency of soil nutrients is dependent upon the plant-soil-moisture-air relationship of the soil, the vigor of the plants growing on it and the amount of leaf surface of plants.

L. D. Baver pointed out in the August 1951 issue of the Agronomy Journal that: (1) Physical properties of soils affect the efficient utilization of fertilizers in at least three ways: restricting root development, impairing normal absorption by established roots, and impeding microbiological activity; (2) The growth of sugar beets and corn is limited by aggregation and porosity. Fertilizer responses are small where these two properties are at a minimum; (3) The use of commercial fertilizers must go hand in hand with the improvement of soil structure if maximum returns are expected.

The following, quoted from J. H. Stallings' analysis "Returns From the Use of Fertilizers on Pasture and Hay Crops," will prove valuable in this discussion. The data used are from unpublished material from Texas Experiment Stations.

NUMBER OF POUNDS OF
DRY MATTER, DIGESTIBLE PROTEIN, 4% MILK AND
LIVE WEIGHT OF BEEF
PRODUCED FROM
1 POUND OF NITROGEN (N), PHOSPHORIC ACID (P_2O_5),
POTASSIUM (K_2O) OR PLANT FOOD IN COMPLETE FERTILIZER
ON LEGUMES AND GRASSES

NITROGEN				PHOSPHORIC ACID				POTASSIUM				PLANT FOOD IN COMPLETE FERTILIZER				NUMBER CROP YEARS AVERAGED
Dry Matter	Digest Protein	4% Milk	Beef	Dry Matter	Digest Protein	4% Milk	Beef	Dry Matter	Digest Protein	4% Milk	Beef	Dry Matter	Digest Protein	4% Milk	Beef	
27.17	5.29	31.55	3.95	28.43	5.53	33.00	4.14	9.01	1.75	10.46	1.31	23.00	4.52	26.69	3.35	16
14.56	2.85	16.91	2.12	69.21	13.46	60.36	10.07					24.42	4.75	28.35	3.55	8
				12.06	2.35	14.00	1.75	6.30	1.23	7.31	.92	3.60	.70	4.18	.52	4
8.41	1.64	9.76	1.22	15.17	2.95	17.61	2.20									9

Dr. M. B. Sturgis, Agronomist, Louisiana State University, has found that under conditions where Phosphoric acid and Potassium are present in sufficient quantities that 1 pound of nitrogen will increase yield of seed cotton 15 pounds, 2 pounds of nitrogen will increase yield of corn 1 bushel, 6 pounds of nitrogen will increase yield of sugar cane 1 ton, and 1 pound of nitrogen will increase yield of rice 1 bushel. From the Florida Experiment Station Bulletin 453, "Poor Forage Produces Poor Cows:" To gain 1 pound in weight a cow has to graze:

1. On unfertilized pasture 31 pounds dry weight or 155 bushels green weight.

2. On a good fertilized pasture 13 pounds dry weight or 65 pounds green weight.

Maintenance of soil fertility level, therefore, requires considerable "know-how" on the part of the operator. He must learn how to combine good management of soil and plants with herd management to get best results.

D. <u>Good Grazing Management Means Longer Life and Greater Production of Pasture Plants</u>

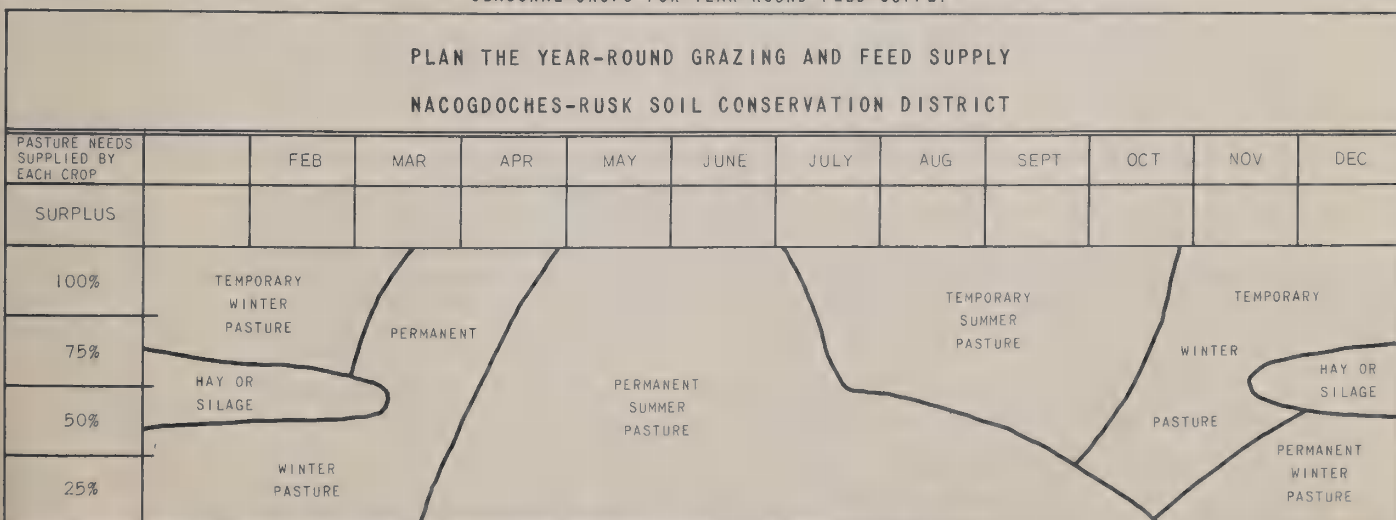
An average 600 pound steer will consume around 60 pounds of green forage per day from a good fertilized pasture. On this basis, considering the gain of the steer, it will require around 29,000 pounds of green forage to carry such an animal for a whole year at an average of 80 pounds per day. This kind of information should be helpful when assisting the farmer plan a grazing program. If the technician knows the adapted plants, the local soils, the climate of the area and fertilizer needs of the soils and plants, he can do a good job of advising the farmer how to plan and maintain his forage needs.

Pastures are seasonal. Some crops grow only in warm weather, others in cool weather, others in the spring, etc. Therefore, arrangement for seasonal pastures must be made.

To grow beef, pork or milk economically green forage must be made available as many days in the year as possible and in quantities sufficient to give every animal all it will take every day and for insurance sake have a surplus. Surpluses can be preserved by making silage or hay.

Three requirements for the best grazing management are (1) to produce more than enough grazing for every day of the year, (2) set up seasonal pastures, and (3) to produce all the supplemental crops needed.

SEASONAL CROPS FOR YEAR-ROUND FEED SUPPLY



SOW IT - GROW IT - LET THE COWS MOW IT

This year-round feed supply chart was prepared for use at Nacogdoches, based on chart originally developed by Edgar A. Hodson, Agronomist, SCS, Little Rock, Arkansas.

Things the cooperator must learn about grass and grass management:

1. The size of a factory usually determines the quantity of goods it can manufacture. The plant being a factory--the area of leaf surface it has will largely govern its ability to grow--provided moisture and raw foods are available. Therefore, close grazing will reduce the quantity of forage for grazing. The importance of this point has been sadly overlooked. Assume, for example, that it is possible, by grazing properly, to produce 29,000 pounds green forage on two acres of pasture--enough to give a 600 pound steer an average of 80 pounds per day for 12 months--provided half of the required N-P-K is added in fertilizer. But the owner decides to graze an extra steer on the two acres. He starts out by grazing his forage short. So short, in fact, that there is leaf surface sufficient to use only the amount of plant nutrients available in the soil. This would leave the commercial fertilizer, or its equivalent, untouched.

   To profitably utilize available plant nutrients in the soil and added fertilizer, the green plant factory must be kept large.

2. Quotation from Agricultural Research, July 1954 issue, "Lay Off the Grass:"

   "When Delilah cropped Samson's locks, the Biblical hero lost his strength till his hair grew out again. The same thing happens to grasses, says F. J. Crider, retired nursery division chief for the Soil Conservation Service, at Beltsville, Maryland.

   "If you remove too much of the grass' top growth by grazing or mowing it closely, the roots will quit growing until the tops recover.

   "Crider found this grue in testing both cool-season and warm-season grass species. Taking off half or more of the foliage during the growing season caused root growth to stop for a time after each clipping. (The lone exception was orchardgrass following the first clipping.)

   "A single cutting that removed most of the foliage stopped root growth--usually within 24 hours--for periods ranging from 6 to 18 days. The grass' root growth didn't resume till the top growth was well advanced. Repeating these severe clippings periodically, as in a system of rotation grazing, prevented root growth of all grasses for 25 to 45 days.

   "The percentage of roots that stopped growing varied with the amount of top that was taken off.

   "With a single clipping of 50 percent of the foliage, 2 to 4 percent of the grass roots stopped growing for 14 days. After that, all the roots were growing again, and the plants were also producing some new roots. But removing 90 percent of the foliage halted root growth completely for 17 days and 40 percent of the roots were still inactive at the conclusion of the 33-day experimental period.

   "Effects of such clippings repeated frequently, simulating continuous grazing, were much more severe.

   "Removing 50 percent of the foliage and clipping it back to that level three times a week stopped growth of 8 percent of the roots

after the first clipping and of 52 percent at the end of the test period. All root growth stopped after the first clipping of 90 percent of the foliage, and subsequent thrice-weekly clippings prevented root growth for the entire test period. Although stoppage was somewhat less as smaller amounts of foliage were removed, no roots were growing at the close of the test where 70 percent or more of the tops had been clipped.

"But removing 40 percent or less of the foliage didn't halt root growth. And clipping parts of bunchgrass plants stopped growth for only those parts. This characteristic would seem to make cattle's 'patchy' grazing a desirable habit.

"Crider also noted that the number of roots at the end of single-clipping tests ranged from 132 at the 10-percent clipping level to 32 at the 90-percent level. In repeated clipping tests, the range was from 156 at the 10-percent clipping level to 0 at the 70-, 80-, and 90-percent levels. And he found that among seven types of grasses that were clipped periodically--2 to 4 times during the growing season--dried roots of unclipped plants weighed eight times as much as those of the clipped plants.

"Crider believes the damage from repeated heavy clippings is significant in soil conservation and pasture management: reducing the top more than half upsets the functioning of the root system and the plant as a whole. Because of continuous suppression of aboveground growth, the grass can't replenish its food reserves. So the effects of root inactivity are lasting. The plant thus weakened is less able to resist erosion and grazing, as well as drought, cold, and disease.

"This is striking evidence that close grazing or mowing during the growing season--especially in periods of stress or in the late fall--may be practiced at the expense of stand establishment and maintenance."

3. The plant's roots are a storehouse for surplus foods for emergencies and for regrowth of the plant. Close grazing reduces the ability of the plant to manufacture surplus food and also reduces the capacity of storage facilities in the roots.

4. Close grazing reduces the amount of cover needed to break the impact of falling raindrops which cause puddling of the soil surface which may curtail water supply needed to grow more grass.

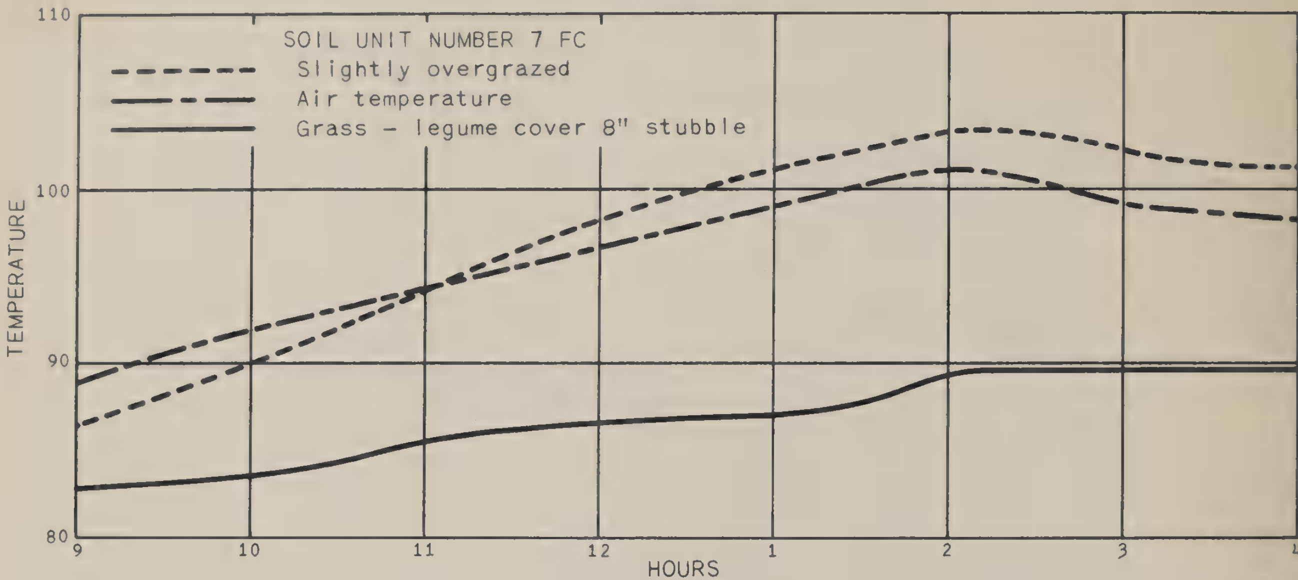
   The graphs (page 16) show the average of several recordings of temperature made on two soil treatment units in good cover, poor cover and the air temperature at different hours of the day. Recordings were made by R. M. Voigtel, Soil Scientist at Nacogdoches.

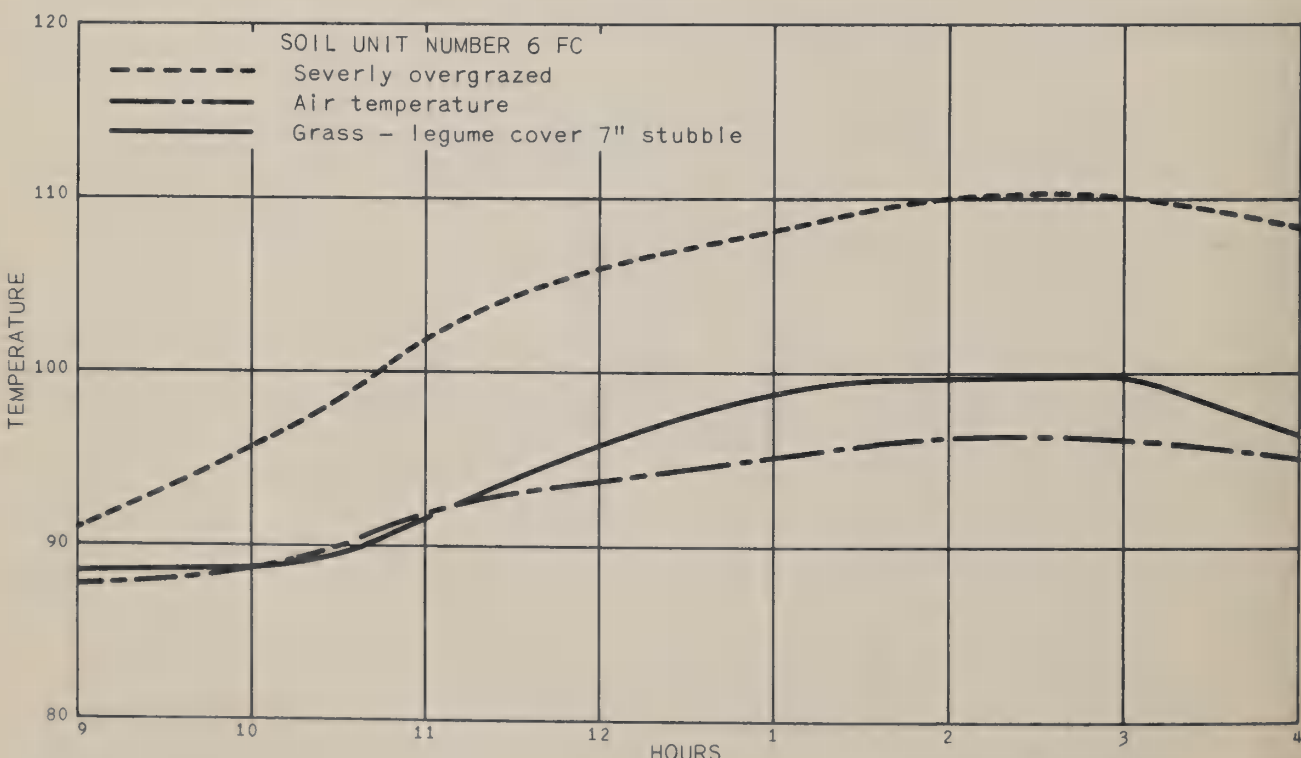
   The graphs show the value of good cover in holding soil temperatures down close to air temperature. Poor cover on the soil permits soil temperatures to run above air temperature.

5. Close grazing will not permit accumulation of enough litter to hold down temperatures, feed the micro-organisms the soil needs, prevent erosion or excessive packing. Such conditions reduce forage production.

   What is meant by proper grazing? Grazing at an intensity which will maintain adequate residues for plant and soil protection, maintain the most

COMPARISON OF TEMPERATURE OR GOOD AND POOR COVER ON TWO SOIL UNITS AS COMPARED TO AIR TEMPERATURE





desirable vegetation or improve the quality of the vegetation where there has been deterioration is proper grazing.

The usual answer to this question when referring to tall grasses is: "Take half and leave half." Such a rule for managing the grazing of tame pastures has been hard to formulate because one needs to know the growth habits of his forage crops to really determine how much can be grazed without cutting its growing ability.

6. Growth Patterns of Pasture Plants

Growth pattern means the way the stems, leaves and roots of a plant develop.

(a) Three types of stem development:

(1) The dominant type--The main stem continues to develop more than any of the branches. Trees, most shrubs, blue lupine, hairy indigo, alfalfa, sweetclover, crimson clover, Louisiana red clover, lespedezas and many warm season grasses belong to this type.

(2) The co-dominant type--Several stems develop at approximately the same rate. The small grains, cool season grasses, yellow lupine, over-wintered alfalfa, sweetclover, sericea lespedeza, kudzu and a few warm season grasses, and Johnsongrass, belong to this type.

(3) The suppressed type--The main stem starts, is suppressed, and the growth is made by lower branches. The vetches, and most of the winter peas belong to this type.

(b) Nodes and internodes:

A node is that part of the stem from which a leaf or several leaves are borne. An internode is that part of the stem between two adjacent nodes.

(c) Branches:

Branches are usually borne from the nodes just above the leaves. The small grains and most bunch grasses produce branches underground or in dense shade at the ground surface. The vetches, winter peas, some bunch grasses, all creeping grasses, alfalfa, sweetclover and true clovers branch above and below ground.

The main stem of crotalarias and blue lupines terminate in a head of blossoms. Branches from the main stems later terminate in a head of blossoms. Branches from the main stems later terminate in similar heads, then sub-branches later produce a third crop of blossoms.

Branching in small grain and cool season grasses occurs mainly when the average temperature is above 50 degrees F. and the soil is fertile enough to promote active growth. In cooler regions this causes a spring and fall season of branching. However, we usually have one season of branching during the fall, winter and early spring for the cool season crops. More than one branch per node is produced on rich land when the temperature remains cool and the day-length not favorable for internode elongation. Vetch and oat plants have been observed with 80 or more basal branches.

When plants are considered on the basis of the above classification it may be easier to determine when they are grazed properly.

Some have suggested that the mathematical rule should be: Watch the crop that is being grazed and when the stubble is cut to 3 or 4 inches it is time to move the herd. But probably the greatest returns in the long run will be obtained if we begin to teach farmers the growth habits of the plants they have in their pastures, and what they look like at different degrees of grazing. For example: How much of a Dallisgrass plant is taken when a stubble of 3 inches remains? Have you really examined the individual plant to see: Why does bermuda still survive when there is so little growth left above ground? Why is carpetgrass so possessive in its characteristics? Why does bermudagrass survive under excessive, close grazing when Johnsongrass will go out under similar conditions? The answers to these questions are found in the growth patterns of those plants. Let's observe them and get farmers to become interested in doing the same. Many of us will be surprised when we find out what part of a Dallasgrass plant is left till the "last bite."

7. Another Management Approach May Be Taken. Since 2000-2500 pounds of crop residue evenly distributed over the soil will just about control erosion we may take that as a minimum standard of management. We then need to become acquainted with what that kind of condition looks like on tame pastures.

Improper grazing can then be considered as anything short of 2500 pounds of stubble and residue.